

National Aeronautics and Space Administration

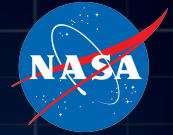


Commercial Crew Planning Status Forum

NASA Exploration Systems Mission Directorate
August 19, 2010



Commercial Crew Planning Status Online



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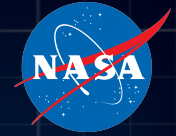
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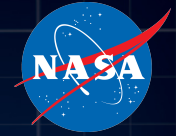
Commercial Crew Overview Agenda



- **The Future State**
- **Objectives and Approach**
- **Framework**
- **Key Attributes of Strategy**
- **Baseline Assumptions**
- **Summary**

All information presented today is for planning purposes only. NASA reserves the right to make any changes to these plans in the future.

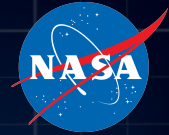
The Future State



- The vision of commercial human spaceflight to low Earth orbit (LEO) is a robust, vibrant, profit-making commercial enterprise with many providers and a wide range of private and public users.
- A successful human space transportation system will: strengthen the International Space Station (ISS) Program; allow NASA to focus on beyond-LEO exploration; potentially reduce the cost of human access to space; and significantly contribute to the national economy.
- NASA's commercial crew initiative will be the next, major step in making this vision a reality.

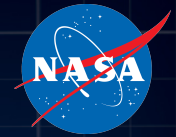


Objectives and Approach



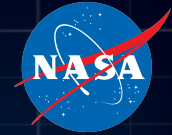
- **The objective of the proposed commercial crew initiative is to facilitate the development of a U.S. commercial crew space transportation capability with the goal of achieving safe, reliable, and cost effective access to and from LEO and the ISS. Once the capability is matured and expected to be available to the government and other customers, NASA could purchase commercial services to meet its ISS crew transportation needs.**
- **Preliminary approach will:**
 - Spur competition through pre-negotiated, milestone-based agreements that support the development, testing, and demonstration of multiple systems.
 - Support a range of higher and lower programmatic risk systems.
 - Require an end-to-end transportation solution, but will encourage the development of a range of launch vehicle and spacecraft combinations.
 - Some amount of industry investment capital will be included as part of any agreement.
 - Clearly and promptly state NASA's safety requirements and ensure that they are met.
 - Lead to the competitive selection of one or more commercial service providers.

Framework



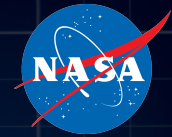
- **The framework should be designed to achieve both program goals:**
 - Safe transport of U.S. and U.S.-designated astronauts to and from the ISS.
 - Support the development of non-NASA markets for commercial human transportation services to and from LEO.
- **Given this, the framework should:**
 - Accommodate a diverse range of potential passengers and crew (e.g., NASA astronauts, international partner personnel, scientists, spaceflight participants) for a variety of reasons (e.g., science, research, ISS operations, tourism), including NASA personnel as crew or participants.
 - Support multiple commercial systems.
 - Incorporate performance goals and a concept of operations that are as high-level as possible, providing commercial providers with maximum flexibility to propose a variety of safe and cost effective system solutions.
 - Obtain NASA human spaceflight certification for ISS crew transportation missions. This will not cover the certification of other NASA missions or non-NASA missions.
 - Accommodate eventual Federal Aviation Administration (FAA) licensing with NASA human spaceflight certification and NASA technical mission assurance oversight.

Key Attributes of Strategy



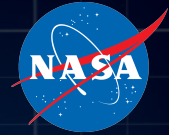
Attribute	Rationale
Performance-based Milestone Payments	Results in low cost-risk to the government
Fixed Government Investment	Permits NASA to support the development of a risk-balanced portfolio of multiple systems
Requires Industry Financial Investment	Supplements government funds and provides strong incentive to the industry partners to perform and “stay in the game”. Also, supports the development of commercial services
Significant Contractor-Retained Intellectual Property	Enables commercial sale and application of capabilities
High-Level Performance goals	Enables cost and system-wide performance optimization by the industry partners, and allows creative solutions
Relief from Requirement for a Government-Approved Accounting System	Relieves industry of the requirement for a government-approved accounting system, thereby expanding the list of potential suppliers
Competition	Incentivizes performance and does not leave the government dependent on sole provider, thereby generally producing lower prices and mitigating the risk of failure of an individual provider
Avoid Traditional Cost-Type Contracting Methods	Traditional contracting methods are not consistent with the program strategy.

Commercial Crew Baseline Assumptions



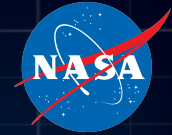
- The President's FY 2011 Budget Request invests \$5.8 billion over five years to spur development of U.S. commercial human spaceflight systems.
- Using previous industry inputs assuming a non-traditional approach, funding multiple providers is feasible.
- Competition is a fundamental aspect of the strategy: incentivizes performance, supports cost-effectiveness, and eliminates NASA dependence on a single provider in the event of provider nonperformance.
- Baseline plan reflects a success-oriented schedule to enable services capability by late 2015 (assumes early FY 2011 authorization to proceed).
- NASA will readjust its plans, if required, to be consistent with Congressional direction in FY 2011 authorization and appropriations laws, once enacted.

Summary



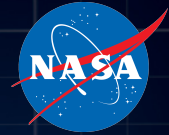
- **The commercial crew initiative is designed to meet the objectives of satisfying NASA's ISS crew transportation needs and enable the growth of a commercial human spaceflight industry for use by NASA and other customers.**
- **If approved by Congress, the commercial crew initiative would represent a new way of doing business in human spaceflight, and it will be well grounded by:**
 - Knowledge gained from prior programs;
 - Thorough human spaceflight certification processes; and
 - Building on the experiences of COTS Cargo, Commercial Resupply Services and Commercial Crew Development (CCDev) activities.
- **When successful, the commercial crew initiative will:**
 - Transform human spaceflight for future generations;
 - Result in safe, reliable, cost-effective crew transportation for the ISS;
 - Free NASA's limited resources for beyond LEO capabilities;
 - Reduce reliance on foreign systems; and
 - Lower the cost of access to space, enhance the U.S. industrial base, and act as a catalyst for the development of other space markets.

Planning Status - Panel Session Agenda



- **Commercial Crew Initiative (CCI) Request For Information (RFI)**
 - Process
 - Common themes
- **Resulting NASA Feedback**
 - Programmatic approach for Commercial Crew Development Program (CCDP)
 - Insight / oversight approach
 - Methodology
 - Level of involvement
 - Insight and oversight team roles
 - Technical Requirements
 - Evaluation of technical standards
 - Failure Tolerance / Integrated safety and design analysis
 - Crew Transportation System Certification and Certification of Flight Readiness (CoFR) processes
 - Liability / Indemnification
- **Facility Usage Philosophy and Availability**
- **Concept of Operations**
- **Roadmap Ahead**

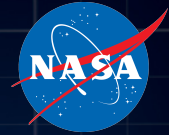
Commercial Crew RFI Process



- **In an effort to obtain feedback and ideas from industry, NASA released an RFI on May 21, 2010**
 - Included an initial version of the Commercial Human Rating Plan (CHRP)
 - Tailored version of NASA Procedural Requirement (NPR) 8705.2B – “Human-Rating Requirements for Space Systems”
 - Three categories of NASA Standards & Processes:
 - Type I: Mandatory Standards; Type II: Meets or Exceeds; Type III: Informational Only
 - Referenced, but not included, were documents that are needed for crew transportation to the International Space Station (ISS)
 - Service Requirements Document (SRD) – System performance requirements
 - Interface Requirements Document (IRD) – Physical and functional interface requirements
- **NASA received 35 responses from industry**
- **NASA reviewed responses and analyzed them to capture major themes**
 - Review team included NASA-wide participation
 - NASA shared information with the FAA

Thank you for participating!

Commercial Crew Initiative RFI Response Themes

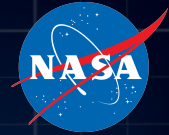


- **Programmatic Approach**
 - CCDP roles and responsibilities
 - Commercial Partner (CP) roles, responsibilities and deliverables
 - General list of optional goals/activities/capabilities/missions
- **Insight/Oversight Plan**
- **Requirements**
 - Tailored NASA Procedural Requirements, standards & processes
 - How will the CP meet intent of NASA standards
 - Define fault tolerance carefully
 - Requirements change process and responsibilities
 - Flight test program and requirements
 - Existing hardware review/acceptance process
 - What are the bottom line set of requirements
 - If NASA imposes a new requirement, who will pay for the implementation?
 - Verification plan/strategy/success criteria
 - Certification process
 - CoFR process
 - Processes/procedures for independent assessment

Blue = topics addressed today

Industry, we heard you!

Commercial Crew Initiative RFI Response Themes

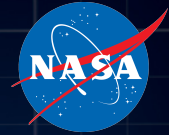


- **Indemnification**
- **FAA involvement/Requirements and licensing process**
- **Government resource usage**
 - What support will NASA provided to CPs
- **Government asset usage**
 - What may be made available to the CP along with the process and cost to obtain
 - What may be made available to the CP along with the process and cost to obtain (e.g., facilities, resources)
 - What are the future infrastructure plans?
- **Acquisition**
 - Intent, schedule, timelines, scope, and phases
 - Acquisition mechanisms for design, development, demonstration and services
 - What is NASA's follow-on intent/guarantee if the company performance is satisfactory during development?

Blue = topics addressed today

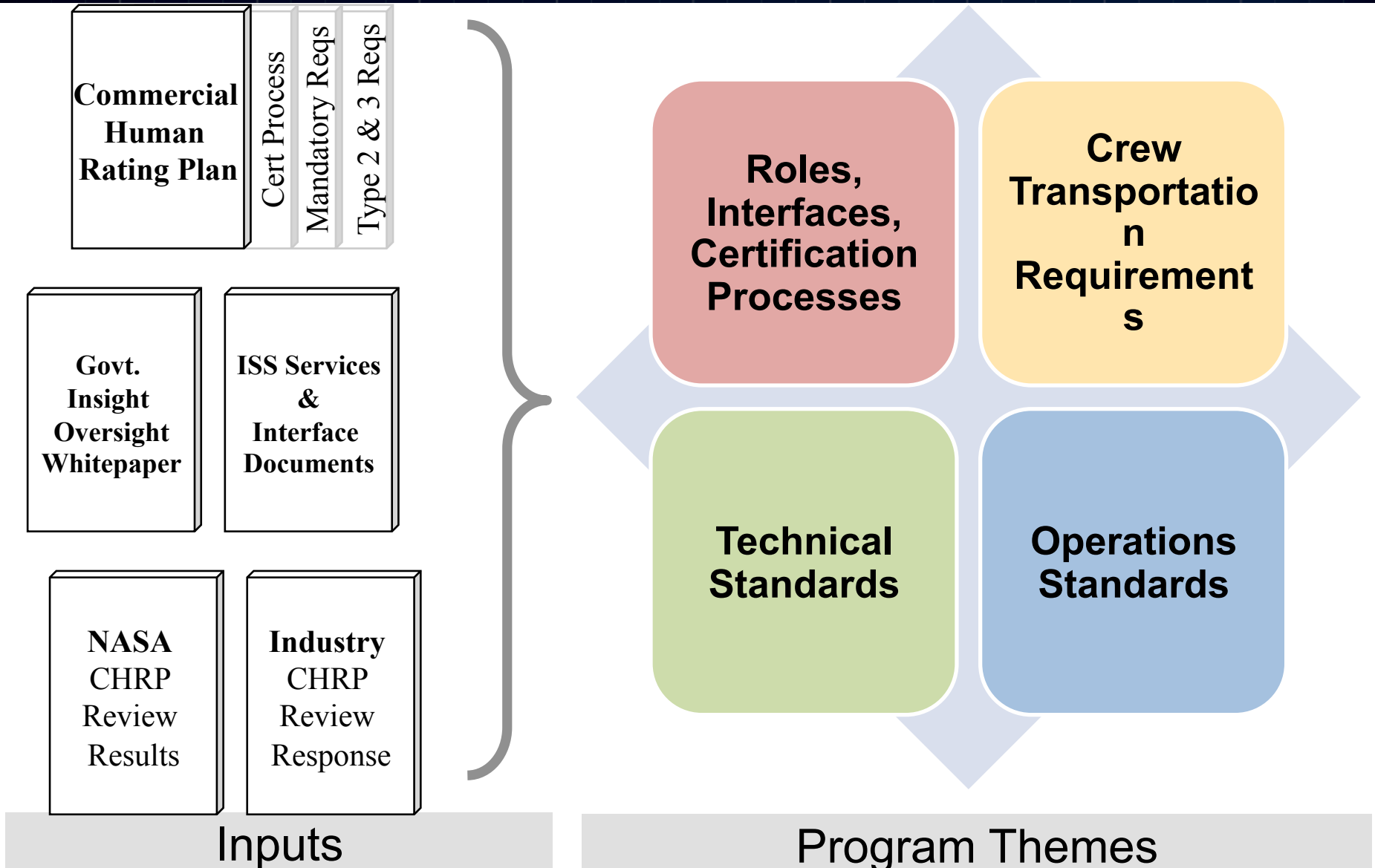
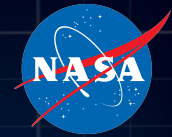
Industry, we heard you!

Programmatic Approach

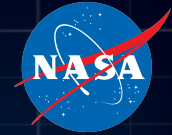


- **Programmatic approach has evolved**
 - With feedback from CHRP reviews – industry and internal
- **Addressing concerns over program control**
 - Establishing clear program authority
 - Proposed CCDP will manage the requirements that govern Crew Transportation System (CTS) Certification (i.e., human rating certification)
 - Streamlining Program Oversight/Control
 - Minimizing sub-boards and panels
 - Other NASA organizations provide inputs to the program control
 - Clarifying interfaces with NASA technical authorities
 - Technical Authorities provide official recommendations to the program, not the CP
 - Clarifying Interfaces with CPs
 - Simplified to address milestone criteria and CTS Certification
- **Addressing concerns with documentation of processes, requirements and standards**

Programmatic Approach



Programmatic Approach



Roles Interfaces Certification Processes

- Roles (including Insight and Oversight)
- Interfaces of NASA's CCDP and the CPs
- Describe the processes for achieving certification to transport NASA/ NASA-sponsored Crew.

Crew Transportation Requirements

- All technical, safety, and crew health & medical requirements that are required for achieving a CTS Certification for ISS designed missions.

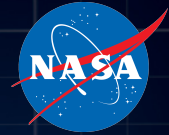
Technical Standards

- Descriptions of technical, safety, and crew health & medical processes and specifications and the criteria which will be used to evaluate the acceptability of the CPs proposed processes and specifications.
- Required for achieving a CTS certification for ISS missions

Operations Standards

- Descriptions of ground and flight operations processes and specifications and the criteria which will be used to evaluate the acceptability of the CPs proposed processes and specifications.
- Required for achieving a CTS certification for ISS missions

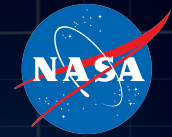
Insight / Oversight Methodology



- **Insight is defined as the capacity to discern the true nature of the project's efforts to design, develop, test and operate the CTS.**
 - Insight will be modeled as a cooperative partnership to assist partner in technical knowledge while providing NASA the ability to penetrate into the partner's designs, processes, and implementation.
- **Oversight is the watchful and responsible care and management of the CPs development, test and operations efforts. The primary elements of oversight require government approval and/or direction.**
 - Oversight will be accomplished by approving/guiding the completion of predetermined milestones and potential issues leading to CTS Certification (proactive insight team communication to oversight).
- **We will not be using NASA's traditional day-to-day oversight model.**
- **We will not sign your procedures and non-conformances.**
- **It is *your* Engineering Review Board.**
 - NASA Insight Team will attend/observe

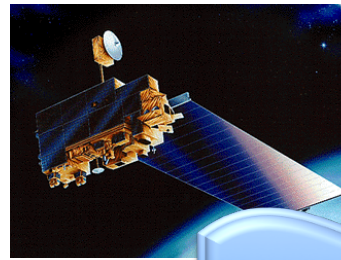
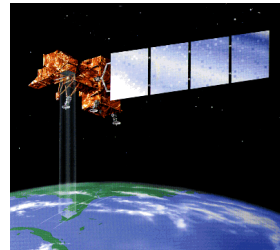
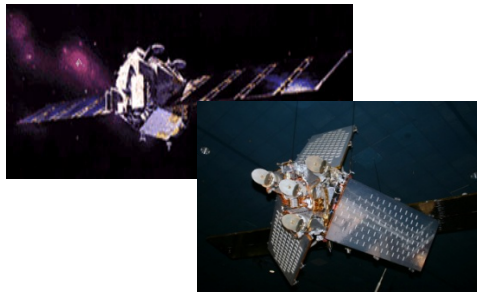
The scope and amount of insight/oversight for specific CPs will vary depending on human spaceflight experience, hardware performance history and proposed design risk.

Insight/Oversight Model – Level of Involvement



- NASA will perform insight/oversight on the CPs design, development, and certification process to evaluate the end-to-end crew transportation system for safe reliable, and cost effective access to and return from LEO.

Scientific & Commercial Spacecraft--Contracted



Human Spaceflight



Commercial Crew

COTS & CRS



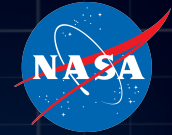
Launch Services Program



Low In/Oversight

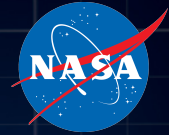
Intense In/Oversight

Insight Team Roles



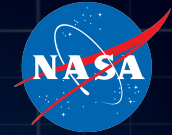
- **NASA insight team members promote collaboration to determine the best approach to meet the CPs goals of progressing toward a NASA CTS Certification.**
 - However, insight personnel are not authorized to issue direction to CP teams.
- **NASA insight manager is the primary, day-to-day point of contact between the CPs and Program (Attends CP meetings, boards, etc).**
- **Insight teams evaluate and make recommendations to the CP and/or oversight team to improve requirements and designs, to align or accelerate milestones, or to address issues.**
- **Utilizes an embedded team for day-to-day CP activity status and access to CP's data via their information systems.**
 - The CP will support the government insight role by providing access to all technical information, alleviating the need for deliverables prior to milestone reviews, and notification of all (appropriate) meetings.
 - Embedded team provides understanding of requirements compliance to the insight and oversight teams and encourages an architecture which ensures safe and successful crew transportation to space.
- **Tracks major problem identification (risks to certification) and resolution efforts, keeping program management informed about overall certification risk.**
- **Overall insight team membership of management, flight crew, engineering and S&MA**
 - Teams may be augmented with Federal Aviation Administration, International Space Station Program, Oversight Office, NASA Engineering and Safety Center (NESC), or system experts for special issues, Technical Interchange Meetings and design reviews (performance of milestone reviews).

Oversight Team Roles

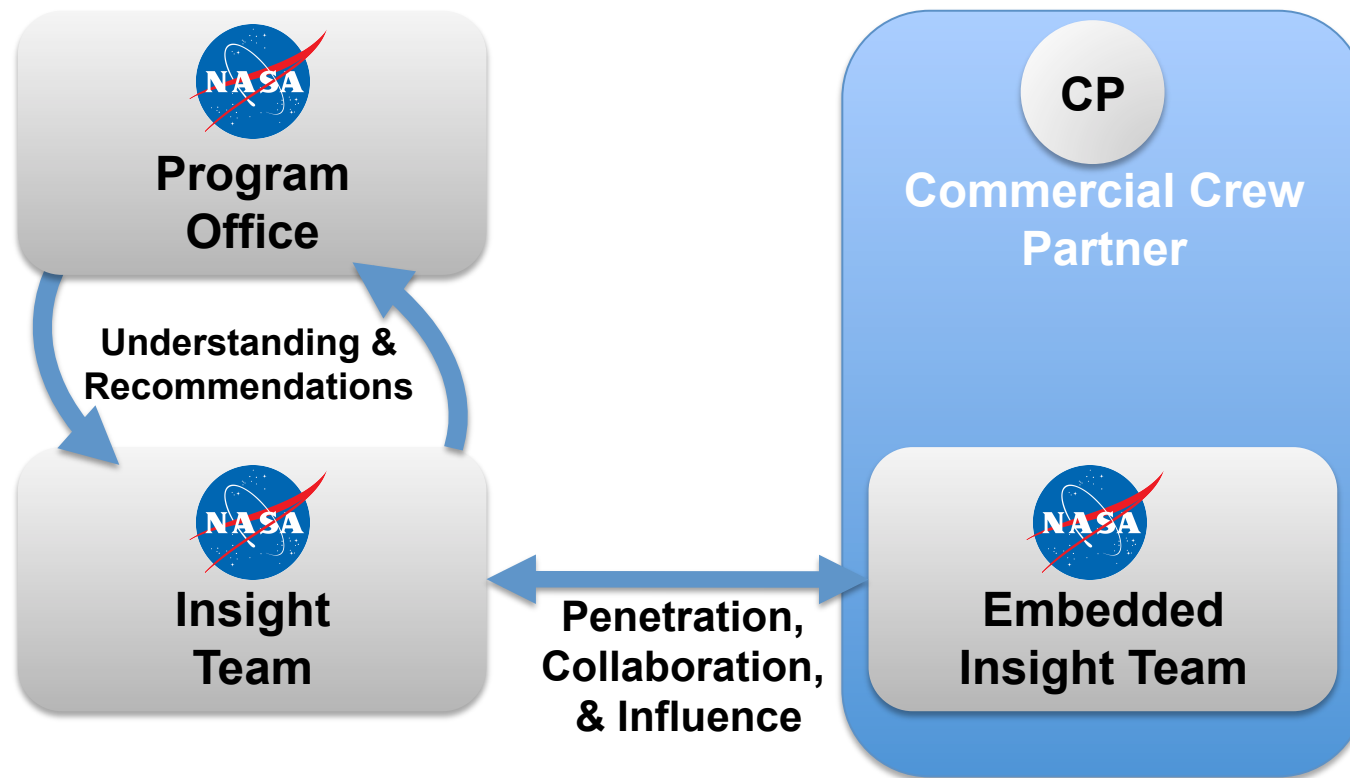


- **Oversight team's primary role is the management, approval, and direction leading to CTS Certification.**
 - Through discrete milestones during design, development, test and verification
- **Will obtain knowledge of CP effort via insight teams**
- **Provides a uniform understanding and management of certification requirements and standards for all CPs.**
 - Especially important in the development and implementation of a standardized integrated safety and design analysis process
 - Coordinates with technical authorities on the tailoring and management of certification requirements and standards
- **Ramps up and down with assistance of insight teams, NESC and institution during major reviews and major issue resolution (insight teams will also ramp up and down as necessary).**

Day-To-Day Communications Path For Insight

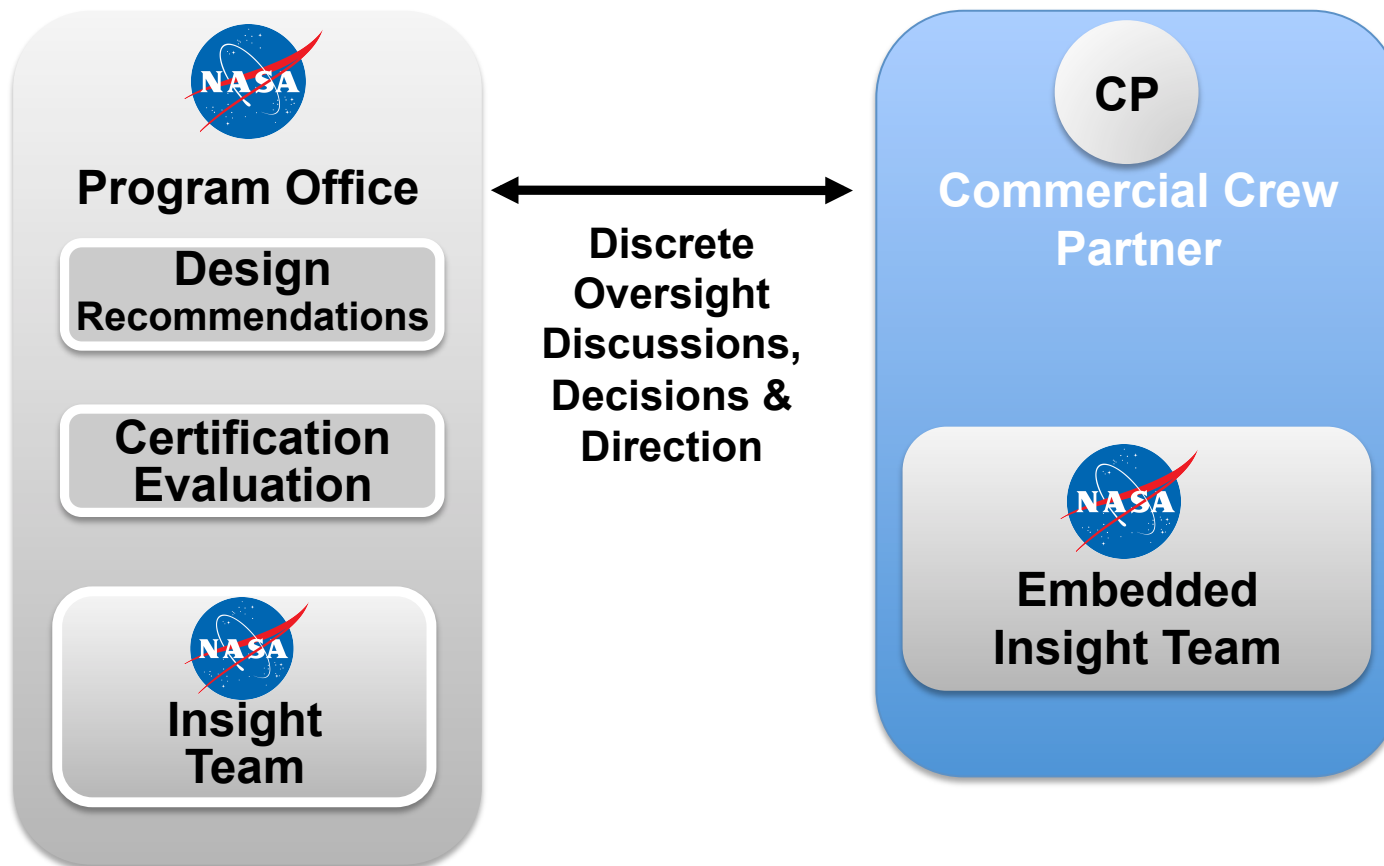
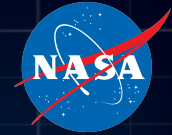


Insight Role: Expert Insight, Early Issue Identification & Recommendations

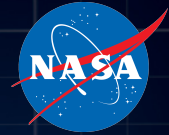


Embedded team represents the long term presence with the CP developing interpersonal relationships and trust to yield significantly greater insight.

Day-To-Day Communications Path For Oversight

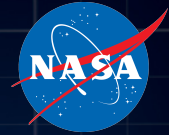


Evaluation of Technical Standards



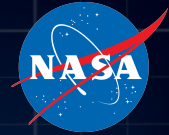
- **Program approach for use of technical standards has evolved**
 - RFI responses indicate that the Appendix B Technical Standards list in the CHRP did not convey NASA's process regarding use of technical standards.
 - The CHRP listed technical standards in Appendix B grouped into three categories based on varying levels of applicability ranging from fully applicable to information only.
 - Insufficient emphasis and clarity
 - No insight into NASA's areas of emphasis within those Standards
 - No expectation provided on the types of products and processes NASA would expect to see in its evaluation of CP proposed standards
- **Addressing concerns to “firm up” NASA expectations on the application of technical standards**

Evaluation of Technical Standards (Cont'd)



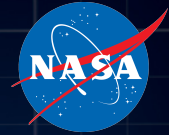
- **CP will identify the Type II standards that will govern their design and engineering practices**
- **CCDP will employ a partnered milestone-based review for the acceptance of standards**
 - Conducted early in development process to mitigate risk
 - NASA will be available to provide clarification on expectations
 - NASA will use internal and external subject matter experts to ensure CP standards are acceptable
 - Review and evaluation process will be open and include full CP participation
- **Accepted CP standards become partnered baseline standards**
 - Integral part of CTS Certification
 - Intended to maintain joint CP and CCDP control over baseline standards
 - Avoids changes to program standards due to evolving technical standards

Failure Tolerance/Integrated Safety and Design Analysis



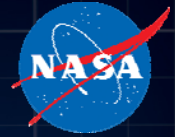
- **CCDP intends to focus on the integrated safety and design analysis process instead of prescriptive failure tolerance requirements to generate a safety-optimized design solution.**
- **CCDP failure tolerance requirements will be based on NPR 8705.2 Revision B “Human-Rating Requirements for Space Systems”.**
 - Additional failure tolerance requirements for ISS operations are defined in SSP 50808 “ISS to COTS IRD”
- **CPs and NASA will collaborate on appropriate level of failure tolerance as part of the integrated safety and design analysis process and the associated impact of loss of crew.**
- **CCDP intends to standardize the integrated safety and design analysis process (currently under development) used for risk assessment during design, development and demonstration.**

Certification and Mission CoFR Processes

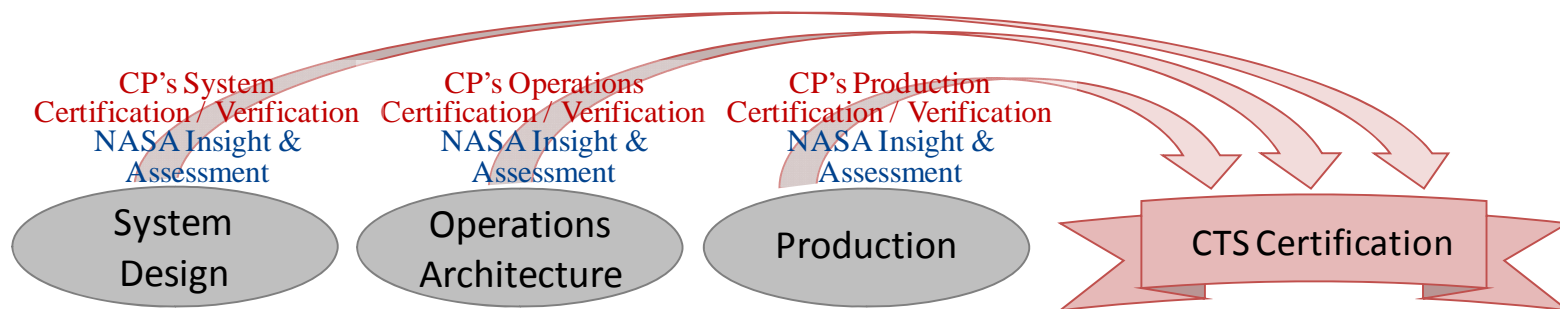


- **CTS Certification and Mission CoFR are the formal processes through which the CP demonstrates that their CTS meets NASA's requirements for crew safety.**
 - Includes the end-to-end vehicle design, production processes, and the planning and processes for ground/mission operations
 - Provides the objective evidence that demonstrates that the CP has achieved the design, performance, and safety requirements
 - Based on results from test, analysis, inspection, and evaluation
- **Existing data (e.g., flight history) can be leveraged for Certification.**
 - Data must be relevant to CTS configuration.
 - The CP must perform assessments and/or analyses to demonstrate that existing data meets the CTS Certification requirements.

CTS Certification Process

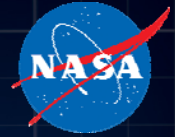


- **CTS Certification is a CP-led and managed process that demonstrates that their end-to-end system will meet all design and/or performance requirements and applicable standards with the prescribed levels of safety and performance margin.**
 - CP defines an end-to-end CTS Certification Plan with NASA approval
 - CP executes the plan
 - NASA Insight Team performs independent review and evaluation throughout
 - Incremental NASA Oversight executed at Milestones Reviews

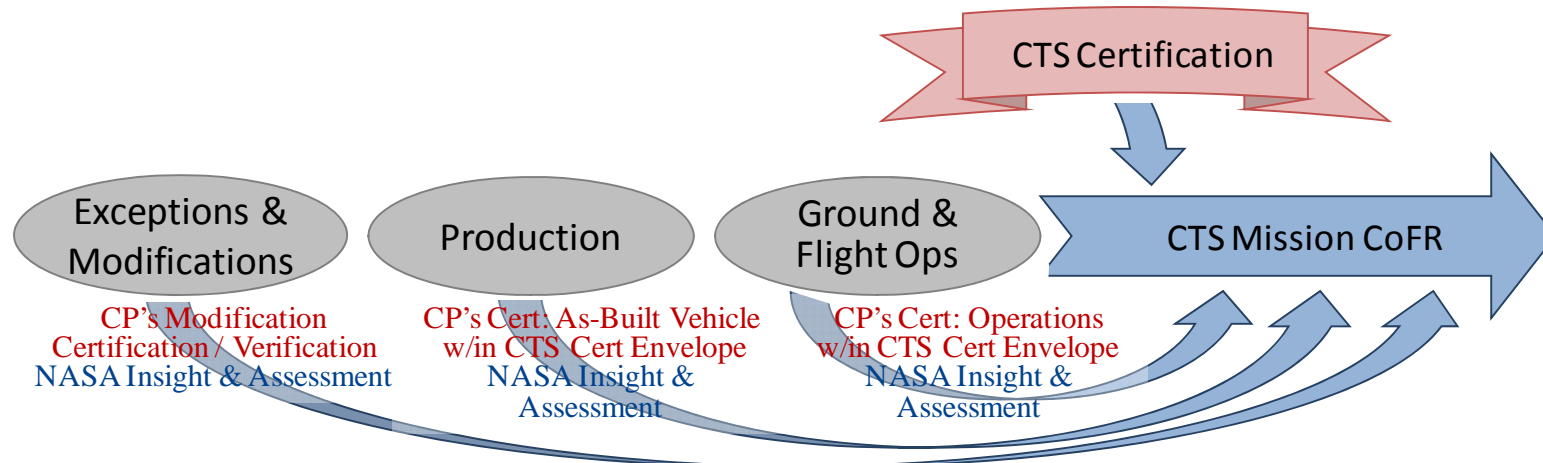


- **CCDP evaluates the end-to-end CTS to certify its capability to provide safe, reliable, and cost effective access to and return from LEO prior to use by NASA/NASA-sponsored crew.**

Mission Certification of Flight Readiness (CoFR) Process

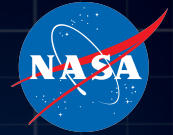


- **Mission CoFR is a CP led and managed process that demonstrates that their mission-specific CTS was manufactured, produced, and integrated within the baseline of NASA's CTS Certification and that all modifications have completed certification.**
 - CP performs hardware production and operations planning activities
 - NASA Insight Team performs independent review and evaluation throughout
 - CP assesses flight readiness
 - Incremental NASA Oversight executed at milestones reviews



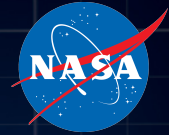
- **CCDP evaluates the production; ground operations processes; mission planning processes; and flight products to validate these key CTS production and operations processes for each mission are maintained and executed within the parameters of the NASA CTS Certification.**

Liability/Indemnification



- **Liability is a major consideration arising from all aspects of the mission**
 - Launch
 - Entry (including unplanned)
 - Proximity operations
 - Crew/spaceflight participant safety
- **Mitigations could include one or more of the following (most require government support):**
 - Commercial insurance
 - Waivers/contracting measures
 - Congressional action to extend FAA indemnification
 - Federal legislation to limit liability under prescribed conditions
- **NASA and FAA are working closely to address**
 - Roles and responsibilities / authority with respect to each phase of the mission
 - Gaps in current FAA regulations
 - Indemnification options and effect on / benefit to commercial industry

Facility Usage Philosophy and Availability

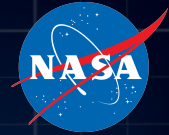


- **Background**

- Space Shuttle retirement will occur sometime next year
- The Space Shuttle Program has been the primary funding source for human spaceflight infrastructure
- NASA was working to understand needs and based on analysis, expected to transition most costs to the Constellation Program
- With the FY 2011 President's budget request a new effort was put in motion to re-evaluate the facility usage situation



Facility Usage Philosophy and Availability (Cont'd)



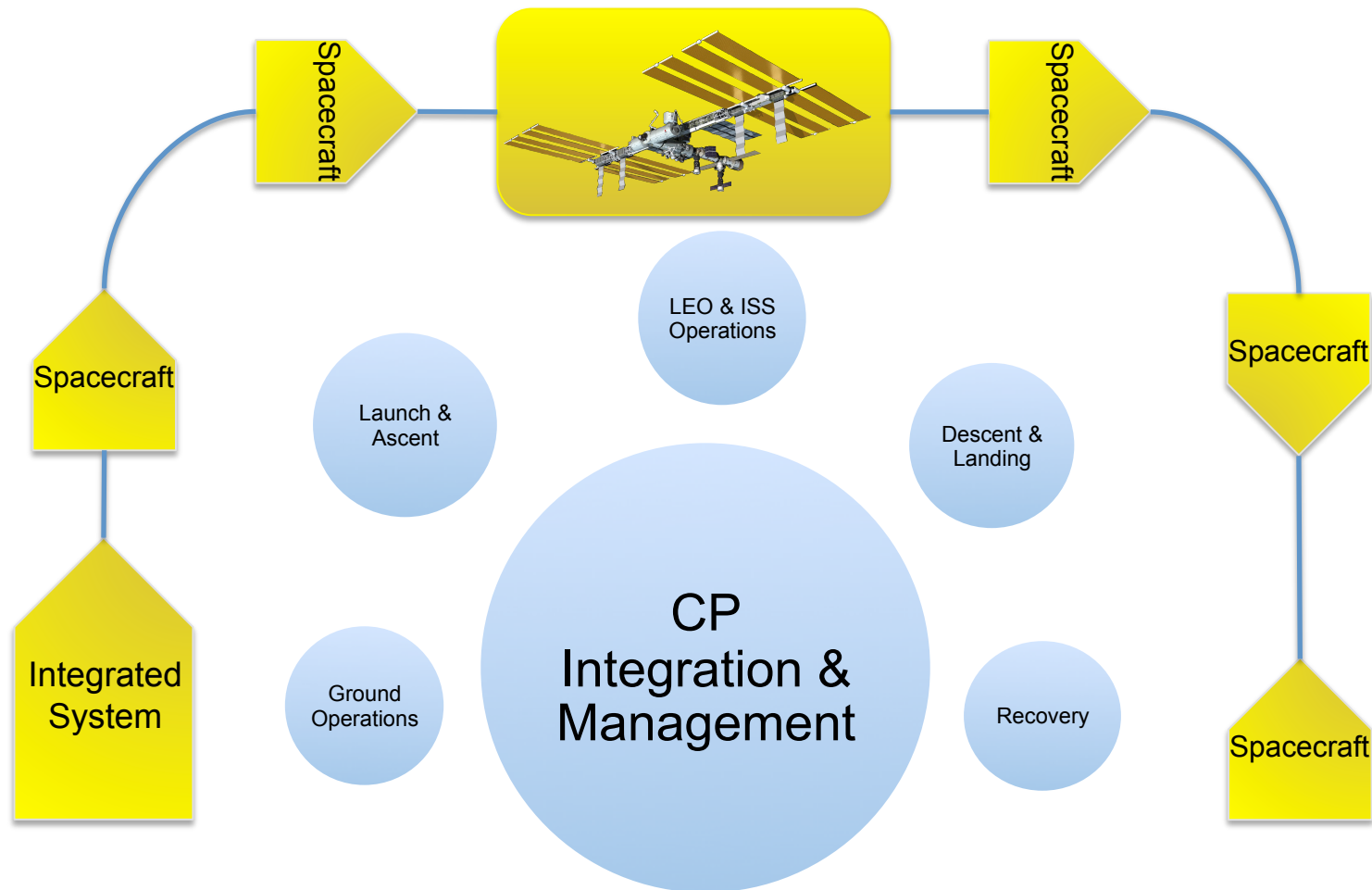
- **Current status:**
 - There is some uncertainty regarding availability of NASA facilities and capabilities.
 - Centers are providing recommendations for facility 'state of readiness' (i.e., demo, mothball, abandon, maintain, etc)
 - A recent NASA policy decision was made that requires users to fund facilities and capabilities as needed.
 - Pricing will vary based on demand and state of facility/capability
 - 21st Century Space Launch Complex may be an avenue for support at Florida's Launch Range
- **What does this mean for the Commercial Crew Initiative?**
 - The Commercial Crew Development Program does not plan on directly funding facility/capability costs or be the broker on behalf of a CP.
 - CPs are encouraged to discuss needs and negotiate facility and capability usage with NASA centers while coordinating with CCDP.

Concept of Operations

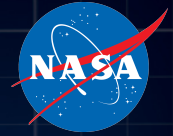


CP Provides End-to-End Integration

- ***Including: Production, processing, launch operations, mission planning, flight operations, crew training, vehicle recovery, crew recovery, vehicle safing, disposal***

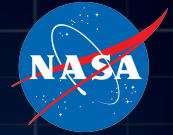


Roadmap Ahead



- **Continue to communicate with Industry**
 - Top level progress and Q&A
- **Multiple touch points**
 - Attempting to have some level of communication each month
- **Program planning team is working the details every day**
 - Current focus of NASA planning team is on definition of requirements, processes and interfaces needed to implement
 - Investment and acquisition planning in work
- **Throughout development and services an end-to-end solution is expected.**
 - CPs are expected to do integration of all flight hardware and flight and ground operations support.
- **Activities will contingent upon final direction and funding levels provided by the FY 2011 budget and related authorization laws, once enacted.**

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